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Estrela et al.

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(54) **UNBALANCED THREE PHASE DELTA
POWER MEASUREMENT APPARATUS AND
METHOD**

6,128,583 A * 10/2000 Dowling
6,154,036 A * 11/2000 Baldwin

324/772
324/509

* cited by examiner

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(56) References Cited

U.S. PATENT DOCUMENTS

5,276,402 A * 1/1994 Schuch 324/107

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(57) **ABSTRACT**

An apparatus and method are used to determine equivalent individual phase voltages and phase currents from an alternating delta power source and load configuration. A delta-wye input transformer and a wye-delta output transformer are interconnected between the delta power source and the delta power load. Each phase of the delta power source is effectively connected across a corresponding wye configured coil. The delta-wye input transformer and the wye-delta output transformer are electrically connected to each other in a manner thereby providing three conductors through which the individual phase currents through the wye coils may be directly measured. The phase voltages are preferably measured across the wye coils of either the input transformer or the output transformer not intermixed. The equivalent individual phase powers and individual power factors from the delta load can then be computed from the current and voltage measurements made using the wye configured coils in the delta-wye and wye-delta transformers.

